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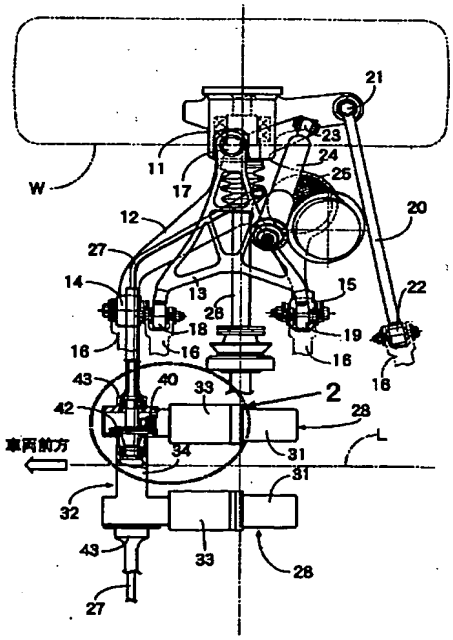
最終頁に続く

(54)【発明の名称】　自動車のサスペンション制御装置

(57)【要約】
【課題】　車輪を上下動させるアクチュエータの取付位置の自由度を高める。
【解決手段】　左右の車輪Ｗと共に上下動する左右のロアアーム１２にトーションバー２７の外端部を接続し、車体中心線Ｌを挟んで同軸に対向する左右のトーションバー２７の内端部を、各々対応するアクチュエータ２８で捩じるように駆動する。これによりアクチュエータ２８の駆動力でトーションバー２７を介して左右の車輪Ｗを上下動させ、ローリングやピッチングの制御を行うことができる。しかもアクチュエータ２８を車体中央部に配置することができるので、アクチュエータ２８が左右の車輪Ｗのサスペンションと干渉し難くなり、アクチュエータ２８の取付位置の自由度を高めることができる。



【特許請求の範囲】
【請求項１】　左右の車輪（W）と共に上下動する部材（１２）に外端部が接続され、内端部が車体中央部において同軸に対向する左右のトーションバー（２７）と、左右のトーションバー（２７）の内端部を各々回転駆動するアクチュエータ（２８，７１）と、を備えたことを特徴とする自動車のサスペンション制御装置。
【請求項２】　前記アクチュエータ（２８）は左右のモータ（３１）を備え、左右のモータ（３１）を左右のトーションバー（２７）の一方の内端部および他方の内端部にそれぞれ接続したことを特徴とする、請求項１に記載の自動車のサスペンション制御装置。
【請求項３】　前記アクチュエータ（７１）は単一のモータ（８６）を備え、そのモータ（８６）のステータ（８７）およびロータ（８８）を左右のトーションバー（２７）の一方の内端部および他方の内端部にそれぞれ接続したことを特徴とする、請求項１に記載の自動車のサスペンション制御装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、アクチュエータによりトーションバーを介して左右の車輪を上下動させる自動車のサスペンション制御装置に関する。
【０００２】
【従来の技術】アクチュエータで左右の車輪を上下動させるサスペンション制御装置は、特開平７－１４９１３０号公報によって公知である。このサスペンション制御装置はモータの回転を減速機構で減速して出力するアクチュエータを備えており、車輪を懸架するサスペンションアームの基端をアクチュエータの出力軸に直結し、あるいはサスペンションアームの基端を支持する支点付近をピニオンおよびセクタギヤを介して前記出力軸に接続している。従って、アクチュエータを駆動することにより、サスペンションアームを積極的に上下動させて乗り心地性能や操縦安定性能の向上を図ることができる。
【０００３】
【発明が解決しようとする課題】ところで上記従来のものは、アクチュエータをサスペンションアームの近傍に設ける必要があるため、アクチュエータの取付位置の自由度が大幅に制約される問題がある。
【０００４】本発明は前述の事情に鑑みてなされたもので、車輪を上下動させるアクチュエータの取付位置の自由度を高めることを目的とする。
【０００５】
【課題を解決するための手段】上記目的を達成するために、請求項１に記載された発明によれば、左右の車輪と共に上下動する部材に外端部が接続され、内端部が車体中央部において同軸に対向する左右のトーションバーと、左右のトーションバーの内端部を各々回転駆動するアクチュエータとを備えたことを特徴とする自動車のサスペンション制御装置が提案される。
【０００６】上記構成によれば、左右の車輪と共に上下動する部材に外端部を接続された左右のトーションバーの内端部を、車体中央部において同軸に対向させてアクチュエータで各々回転駆動することにより、アクチュエータの駆動力でトーションバーを介して左右の車輪を上下動させ、ローリングやピッチングの制御を行うことができる。しかもアクチュエータを車体中央部に配置することができるので、アクチュエータが左右の車輪のサスペンションと干渉し難くなり、アクチュエータの取付位置の自由度を高めることができる。
【０００７】また請求項２に記載された発明によれば、請求項１の構成に加えて、前記アクチュエータは左右のモータを備え、左右のモータを左右のトーションバーの一方の内端部および他方の内端部にそれぞれ接続したことを特徴とする自動車のサスペンション制御装置が提案される。
【０００８】上記構成によれば、アクチュエータの左右のモータで左右のトーションバーの内端部をそれぞれ駆動するので、左右の車輪を同位相、逆位相あるいは単独で上下動させてローリングおよびピッチングを効果的に制御することができる。
【０００９】また請求項３に記載された発明によれば、請求項１の構成に加えて、前記アクチュエータは単一のモータを備え、そのモータのステータおよびロータを左右のトーションバーの一方の内端部および他方の内端部にそれぞれ接続したことを特徴とする自動車のサスペンション制御装置が提案される。
【００１０】上記構成によれば、単一のモータで左右のトーションバーの内端部をそれぞれ逆方向に駆動するので、左右の車輪を逆位相で上下動させてローリングを効果的に制御することができ、しかもモータの数が１個で済むので部品点数、重量およびコストの削減に寄与することができる。
【００１１】尚、実施例のロアアーム１２は本発明の車輪と共に上下動する部材に対応する。
【００１２】
【発明の実施の形態】以下、本発明の実施の形態を、添付図面に示した本発明の実施例に基づいて説明する。
【００１３】図１～図５は本発明の第１実施例を示すもので、図１は自動車の右後輪のサスペンションの平面図、図２は図１の２部拡大断面図、図３は図２の要部拡大図、図４は図２の４－４線断面図、図５はプラネタリキャリヤ組立体の斜視図である。
【００１４】図１は四輪駆動車両の右後輪のサスペンションを示すもので、車輪Wを回転自在に支持するナックル１１はA型のロアアーム１２およびアッパーアーム１３を介して上下動可能に支持される。ロアアーム１２は先端に設けたボールジョイント（図示せず）を介してナックル１１の下部に接続され、基端に設けた一対のゴム

ブッシュジョイント１４，１５を介して車体１６に接続される。アッパーアーム１３は先端に設けたボールジョイント１７を介してナックル１１の上部に接続され、基端に設けた一対のゴムブッシュジョイント１８，１９を介して車体１６に接続される。更にナックル１１の後部と車体１６とがラテラルリンク２０および２個のゴムブッシュジョイント２１，２２を介して接続される。またロアアーム１２の先端側に設けたゴムブッシュジョイント２３にショックアブソーバ２４の下端が接続され、ロアアーム１２の中央に設けたばね座に懸架ばね２５の下端が支持される。エンジンの駆動力を伝達するドライブシャフト２６がナックル１１を貫通して車輪Wに接続される。

【００１５】「へ」字状に形成されたトーションバー２７は、中間の屈曲部から車体外側後方に延びる部分の外端部がロアアーム１２に連結され、中間の屈曲部から車体内側に延びる部分の内端部が車体中心線Ｌの近傍まで延びている。従って、左右のトーションバー２７，２７の内端部は車体中心線Ｌを挟んで同軸に対向しており、その対向部間に左右のアクチュエータ２８，２８が配置される。左右のアクチュエータ２８，２８は車体中心線Ｌを挟んで左右対称な構造を持ち、各々のアクチュエータ２８が対応するトーションバー２７の内端部を捩じるように回転駆動する。

【００１６】しかして、車両の走行に伴って車輪Wと共にナックル１１が上下動し、ナックル１１に接続されたロアアーム１２およびアッパーアーム１３が車体１６に支持された基端を支点として上下動すると、ロアアーム１２に接続されたショックアブソーバ２４および懸架ばね２５が伸縮して車輪Wの上下動が緩衝される。そしてアクチュエータ２８を駆動してトーションバー２７の内端部を捩じるように回転させると、そのトーションバー２７の外端部に接続されたロアアーム１２が上下動する。従って、左右の車輪W，Wにそれぞれ対応するアクチュエータ２８，２８を相互に関連して駆動することにより、車両のローリングやピッチングを積極的に制御することができる。

【００１７】次に、図２～図５に基づいてアクチュエータ２８の構造を説明する。

【００１８】アクチュエータ２８はモータ３１と減速ギヤボックス３２とから構成されており、減速ギヤボックス３２は車体前後方向に延びる左右一対の第１ハウジング３３，３３と、左右の第１ハウジング３３，３３の前端間を接続して車体左右方向に延びる第２ハウジング３４とを備える。第１ハウジング３３は概略円筒状の部材であって、その後端にモータ３１が同軸に結合される。第１ハウジング３３の後端開口部から挿入されたカップ状のホルダー３５にボールベアリング３６を介して入力軸３７が支持されており、この入力軸３７の後端はモータ３１の回転軸３１ａにスプライン結合される。減速ギヤボックス３２は例えば車体のリヤサブフレームに固定されるため、車輪Wの上下動によりトーションバー２７が曲げ荷重を受けることになるが、その曲げ荷重はトーションバー２７の弾性変形により吸収される。

【００１９】入力軸３７の回転は第１ハウジング３３の内部に収納した３セットの遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚを介して減速され、第１ハウジング３３の前端にボールベアリング３８で支持された出力軸３９に出力される。３セットの遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚは同軸上に直列に配置されるもので、実質的に同じ構造を備えているが、その軸方向の幅が入力側から出力側に向かって順次増加している。その理由は、減速によって伝達トルクが増加するため、その伝達トルクに耐えるようにギヤの厚さを増加させる必要があるためである。

【００２０】先ず、出力側の第３遊星歯車機構Ｐｚの構造を説明する。第３遊星歯車機構Ｐｚはサンギヤ５６ｚ、リングギヤ５７ｚ、３個のプラネタリギヤ５８ｚ…、３本のプラネタリギヤ軸５９ｚ…およびプラネタリキャリヤ６０ｚを備える。プラネタリキャリヤ６０ｚは、円板状の第１側板６０ａと、第１側板６０ａの外周から１２０°間隔で軸方向に延びる３本の脚部６０ｂ…と、脚部６０ｂ…の先端に結合される円板状の第２側板６０ｃとを備えており、第１側板６０ａおよび第２側板６０ｃの中央にそれぞれ円形の開口６０ｄ，６０ｅが形成される。３本のプラネタリギヤ軸５９ｚ…の両端は第１側板６０ａおよび第２側板６０ｃにそれぞれ固定されており、これらプラネタリギヤ軸５９ｚ…にプラネタリギヤ５８ｚ…がニードルベアリング６１ｚ，６１ｚを介して支持される。プラネタリギヤ５８ｚ…の一部は、隣接する脚部６０ｂ…と一対の側板６０ａ，６０ｃとによって囲まれた開口から外部に突出している。これらプラネタリキャリヤ６０ｚ、３本のプラネタリギヤ軸５９ｚ…およびプラネタリギヤ５８ｚ…は、第３プラネタリキャリヤ組立体６２ｚ（図５参照）として予め組み立てられる。

【００２１】第３遊星歯車機構Ｐｚの各プラネタリギヤ５８ｚは、捩じれ方向が相互に逆なヘリカルギヤから成る一対のギヤ半体５１ｚ，５１ｚを背中合わせに組み合わせて構成される。一対のギヤ半体５１ｚ，５１ｚには同一部品が用いられており、その一方の表裏を反転させて使用することにより、部品の種類を減少させてコストを削減することができる

第２遊星歯車機構Ｐｙのプラネタリキャリヤ６０ｙは、第３遊星歯車機構Ｐｚのプラネタリキャリヤ６０ｚの側板６０ｃに形成された開口６０ｅ（図５参照）の代わりに、側板６０ｃの中央部から突出するサンギヤ軸６０ｆ（図３参照）を備える。前記サンギヤ軸６０ｆにスプライン結合される第３遊星歯車機構Ｐｚのサンギヤ５６ｚは、捩じれ方向が相互に逆なヘリカルギヤから成る一対のギヤ半体５２ｚ，５２ｚを背中合わせに組み合わせて

構成される。第３遊星歯車機構Ｐｚのリングギヤ５７ｚは、捩じれ方向が相互に逆なヘリカルギヤから成る一対のギヤ半体５３ｚ，５３ｚを背中合わせに組み合わせて構成されており、第１ハウジング３３の内周に嵌合してピン５４…で回り止めされ、第１ハウジング３３の段部３３ａに当接して軸方向に固定される。サンギヤ５６ｚの一対のギヤ半体５２ｚ，５２ｚを同一部品で構成して一方の表裏を反転させて使用することにより、部品の種類を減少させてコストを削減することができ、同様にリングギヤ５７ｚの一対のギヤ半体５３ｚ，５３ｚを同一部品で構成して一方の表裏を反転させて使用することにより、部品の種類を減少させてコストを削減することができる。

【００２２】第１遊星歯車機構Ｐｘおよび第２遊星歯車機構Ｐｙの構造は第３遊星歯車機構Ｐｚの構造と実質的に同じであり、その符号は第３遊星歯車機構Ｐｚの構成要素の符号の添字ｚを、それぞれｘおよびｙに変更したものである。また第２、第３遊星歯車機構Ｐｙ，Ｐｚのサンギヤ５６ｙ，５６ｚはプラネタリキャリヤ６０ｘ，６０ｙに設けたサンギヤ軸６０ｆ，６０ｆにスプライン結合されるが、第１遊星歯車機構Ｐｘのサンギヤ５６ｘは入力軸３７に一体に形成される。

【００２３】第１プラネタリキャリヤ組立体６２ｘのサンギヤ５６ｘとプラネタリキャリヤ６０ｘ内面との間にスラストベアリング６６が配置され、第２プラネタリキャリヤ組立体６２ｙのサンギヤ５６ｙとプラネタリキャリヤ６０ｙ内面との間にスラストベアリング６７が配置され、第３プラネタリキャリヤ組立体６２ｚのサンギヤ５６ｚと出力軸３９との間にスラストベアリング６８が配置され、第３プラネタリキャリヤ組立体６２ｚが出力軸３９にスプライン結合される。そして第１～第３遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚのプラネタリギヤ５８ｘ…，５８ｙ…，５８ｚ…は、それぞれ対応するサンギヤ５６ｘ，５６ｙ，５６ｚおよびリングギヤ５７ｘ，５７ｙ，５７ｚに噛合する。

【００２４】出力軸３９の前端に設けた駆動ベベルギヤ４０が、第２ハウジング３４にボールベアリング４１を介して支持したギヤ軸４５に固定した従動ベベルギヤ４２に噛合しており、従動ベベルギヤ４２にトーションバー２７の内端部がスプライン結合される。トーションバー２７の内端部から所定の範囲は、第２ハウジング３４の開口端に結合されたカバー４３に覆われてボールベアリング４４により支持される。

【００２５】而して、モータ３１を駆動すると、その回転軸３１ａの回転は入力軸３７を経て第１遊星歯車機構Ｐｘのサンギヤ５６ｘに伝達される。すると、回転するサンギヤ５６ｘおよび停止したリングギヤ５７ｘに噛合するプラネタリギヤ５８ｘ…がプラネタリギヤ軸５９ｘ…回りに回転しながら、第１プラネタリキャリヤ組立体６２ｘがサンギヤ５６ｘよりも減速されて回転する。このようにして第１プラネタリキャリヤ組立体６２ｘが回転すると、その回転は第１プラネタリキャリヤ組立体６２ｘのサンギヤ軸６０ｆにスプライン結合された第２遊星歯車機構Ｐｙのサンギヤ５６ｙに伝達される。

【００２６】第２遊星歯車機構Ｐｙのサンギヤ５６ｙの回転は減速されて第２プラネタリキャリヤ組立体６２ｙに出力され、第２プラネタリキャリヤ組立体６２ｙのサンギヤ軸６０ｆにスプライン結合７０された第３遊星歯車機構Ｐｚのサンギヤ５６ｚの回転は減速されて第３プラネタリキャリヤ組立体６２ｚに出力される。その結果、第３プラネタリキャリヤ組立体６２ｚにスプライン結合された出力軸３９が回転する。出力軸３９が回転は駆動ベベルギヤ４０および従動ベベルギヤ４２を介してトーションバー２７の内端部に伝達され、その内端部をモータ２１の回転方向に応じて捩じるように回転させる。

【００２７】従って、左右のトーションバー２７，２７を介して左右のロアアーム１２，１２を上下に揺動させ、左右の車輪Ｗ，Ｗを逆位相に上下動させることができるので、車両のローリングが検知されたときに、そのローリングを抑制することが可能となる。また左右の車輪Ｗ，Ｗを同位相に上下動させることも可能であり、これによりショックアブソーバ２４や懸架ばね２５の特性を変化させてピッチングモーメント制御やスカイフック制御を実現することができる。

【００２８】このよう、減速ギヤボックス３２の内部で３セットの遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚを直列に接続したので、コンパクトな構造で大きな減速比を確保し、トーションバー２７を大きなトルクで確実に駆動することができる。また左右のアクチュエータ２８，２８が車体中心線Ｌの近傍に配置されるので、アクチュエータ２８，２８が左右のサスペンションと干渉するのを回避してレイアウトの自由度を大幅に増加させることができる。

【００２９】また第１～第３遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚのプラネタリキャリヤ組立体６２ｘ，６２ｙ，６２ｚは、そのプラネタリキャリヤ６０ｘ，６０ｙ，６０ｚの一対の側板６０ａ，６０ｃが３本の脚部６０ｂ…で一体に結合されてボックス状の構造となっているため、一対の側板を３本のプラネタリギヤ軸だけで結合した従来のものに比べて剛性を大幅に高めることが可能となり、プラネタリキャリヤ６０ｘ，６０ｙ，６０ｚの歪みによるトルク伝達効率の低下や、各ギヤの噛合部の摩耗による耐久性の低下を防止することができる。

【００３０】また第１～第３遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚのサンギヤ５６ｘ，５６ｙ，５６ｚ、プラネタリギヤ５８ｘ…，５８ｙ…，５８ｚ…およびリングギヤ５７ｘ，５７ｙ，５７ｚが、捩じれ方向が相互に逆なヘリカルギヤから成る一対のギヤ半体５１ｘ～５１ｚ，５２ｘ～５２ｚ，５３ｘ～５３ｚを背中合わせに組み合わせて

構成されるので、噛合騒音の小さいヘリカルギヤの長所をそのまま生かしながら、ヘリカルギヤの短所であるスラスト力の発生を軽減することができる。即ち、捩じれ方向が相互に逆な一対のヘリカルギヤを組み合わせることにより、両ヘリカルギヤが互いに押し合うスラスト力を発生する場合には、それらスラスト力を完全に相殺することができる。また両ヘリカルギヤが相互に離反する方向のスラスト力を発生する場合には、それらスラスト力を２方向に分散させて実質的に半分に減少させることができる。これにより、前記スラスト力を支持するスラストベアリング６６～６８を小型化し、あるいは廃止することができる。

【００３１】また捩じれ方向が相互に逆な一対のヘリカルギヤを組み合わせる代わりに、山歯ギヤ（ダブルヘリカルギヤ）を採用しても同様の効果を得ることができる。しかしながら山歯ギヤは加工が面倒でコストが嵩む問題があり、それに対して本実施例のヘリカルギヤは加工が容易で低コストである。しかもプラネタリギヤ５８ｘ…，５８ｙ…，５８ｚ…の全てのギヤ半体５２ｘ…，５２ｙ…，５２ｚ…はサンギヤ５６ｘ，５６ｙ，５６ｚおよびリングギヤ５７ｘ，５７ｙ，５７ｚの両方に噛合するので、プラネタリギヤ５８ｘ…，５８ｙ…，５８ｚ…のギヤ半体５２ｘ…，５２ｙ…，５２ｚ…がサンギヤ５６ｘ，５６ｙ，５６ｚおよびリングギヤ５７ｘ，５７ｙ，５７ｚを何れか一方だけに噛合させた場合に比べて、トルク伝達容量を高めることができる。

【００３２】次に、図６および図７に基づいて本発明の第２実施例を説明する。

【００３３】第１実施例ではアクチュエータ２８のモータ３１および第１ハウジング３３が車体前後方向に配置されていたが、第２実施例ではアクチュエータ２８のモータ３１および第１ハウジング３３がトーションバー２７の後部に沿って車体左右方向配置されている点で異なっている。第１ハウジング３３に収納された第１～第３遊星歯車機構Ｐｘ，Ｐｙ，Ｐｚの構造は第１実施例のものと同一であるが、出力軸３９の回転をトーションバー２７に伝達する構造が、第１ハウジング３３の配置方向の変更に応じて変更されている。

【００３４】即ち、第１実施例では出力軸３９とトーションバー２７の内端部とが直交しているために、出力軸３９の回転を駆動ベベルギヤ４０および従動ベベルギヤ４２を介してトーションバー２７に伝達していたが、第２実施例では出力軸３９とトーションバー２７の内端部とが平行であるために、出力軸３９の回転を駆動スパーギヤ４０′および従動スパーギヤ４２′を介してトーションバー２７に伝達している。しかして、本実施例によっても、第１実施例と同様の作用効果を奏することができる。

【００３５】次に、図８および図９に基づいて本発明の第３実施例を説明する。

【００３６】第１、第２実施例が左右の車輪Ｗ，Ｗに対応して左右一対のアクチュエータ２８，２８を備えているのに対し、第３実施例は左右の車輪Ｗ，Ｗに対応して単一のアクチュエータ７１を備えており、このアクチュエータ７１で左右のトーションバー２７，２７が相互に逆方向に捩じられる。

【００３７】アクチュエータ７１のハウジング７２は、中央左寄りの位置に小径部７３ａが形成された概略円筒状のハウジング本体７３と、ハウジング本体７３の左端部に結合されて遊星歯車機構収納室７４を区画する左カバー７５と、ハウジング本体７３の右端部に結合される右カバー７６とを備える。右側のトーションバー２７はハウジング７２の内部を貫通し、その内端部は遊星歯車機構収納室７４の内部に延びており、左側のトーションバー２７の内端部はハウジング７２の左カバー７５に固定されている。

【００３８】遊星歯車機構収納室７４の内部に収納された遊星歯車機構７７は、プラネタリキャリヤ７８と、リングギヤ７９と、サンギヤ８０と、複数のピニオンシャフト８１…と、複数のピニオン８２…とから構成されており、プラネタリキャリヤ７８は右側のトーションバー２７の内端部に固定され、リングギヤ７９はハウジング本体７３に固定され、サンギヤ８０はハウジング本体７３および右カバー７６にボールベアリング８３，８４で支持された筒状の回転軸８５に固定されている。プラネタリキャリヤ７８に固定したピニオンシャフト８１…に支持されたピニオン８２…は、リングギヤ７９およびサンギヤ８０に同時に噛合する。

【００３９】ハウジング本体７３に収納されたモータ８６は、ハウジング本体７３の内周面に固定された永久磁石よりなるステータ８７と、回転軸８５の外周に固定されたコイルよりなるロータ８８とを備える。

【００４０】従って、モータ８６を駆動するとステータ８７に対してロータ８８が回転し、ロータ８８の回転は回転軸８５を経て遊星歯車機構７７の入力部材であるサンギヤ８０に入力され、その出力部材であるプラネタリキャリヤ７８から出力されて右側のトーションバー２７の内端部に一方向の捩じりを与える。その結果、右側のトーションバー２７の捩じり荷重の反力が、モータ８６のステータ８７からハウジング本体７３および左カバー７５を介して左側のトーションバー２７に伝達され、そのトーションバー２７の内端部に右側のトーションバー２７と逆の他方向の捩じりを与る。その結果、左右のトーションバー２７，２７は等しいトルクで相互に逆方向に捩じられ、左右の車輪Ｗ，Ｗの一方を押し上げて他方を押し下げることにより、所望のロールモーメントを発生させることができる。

【００４１】本実施例によっても、アクチュエータ７１を車体中心線Ｌの近傍に配置することができるので、アクチュエータ７１が左右のサスペンションと干渉するの

を回避してレイアウトの自由度を大幅に増加させることができる。しかも単一のアクチュエータ７１で左右の車輪W，Wを上下動させることができるので、第１、第２実施例に比べて構造が簡単になり、部品点数およびコストを更に削減することができる。

【００４２】以上、本発明の実施例を詳述したが、本発明はその要旨を逸脱しない範囲で種々の設計変更を行うことが可能である。

【００４３】例えば、実施例ではトーションバー２７，２７の左右方向外端部をロアアーム１２，１２に接続しているが、車輪W，Wと共に上下動する部材（例えば、アッパーアーム１３，１３やナックル１１，１１）に接続することができる。また実施例では本発明を後輪のサスペンションに適用しているが、それを前輪のサスペンションに適用することも可能である。

【００４４】

【発明の効果】以上のように請求項１に記載された発明によれば、左右の車輪と共に上下動する部材に外端部を接続された左右のトーションバーの内端部を、車体中央部において同軸に対向させてアクチュエータで各々回転駆動することにより、アクチュエータの駆動力でトーションバーを介して左右の車輪を上下動させ、ローリングやピッチングの制御を行うことができる。しかもアクチュエータを車体中央部に配置することができるので、アクチュエータが左右の車輪のサスペンションと干渉し難くなり、アクチュエータの取付位置の自由度を高めることができる。

【００４５】また請求項２に記載された発明によれば、アクチュエータの左右のモータで左右のトーションバーの内端部をそれぞれ駆動するので、左右の車輪を同位相、逆位相あるいは単独で上下動させてローリングおよびピッチングを効果的に制御することができる。

【００４６】また請求項３に記載された発明によれば、単一のモータで左右のトーションバーの内端部をそれぞれ逆方向に駆動するので、左右の車輪を逆位相で上下動させてローリングを効果的に制御することができ、しかもモータの数が１個で済むので部品点数、重量およびコストの削減に寄与することができる。

【図面の簡単な説明】

【図１】自動車の右後輪のサスペンションの平面図

【図２】図１の２部拡大断面図

【図３】図２の要部拡大図

【図４】図２の４－４線断面図

【図５】プラネタリキャリヤ組立体の斜視図

【図６】第２実施例に係るアクチュエータの平面図

【図７】図６の要部拡大断面図

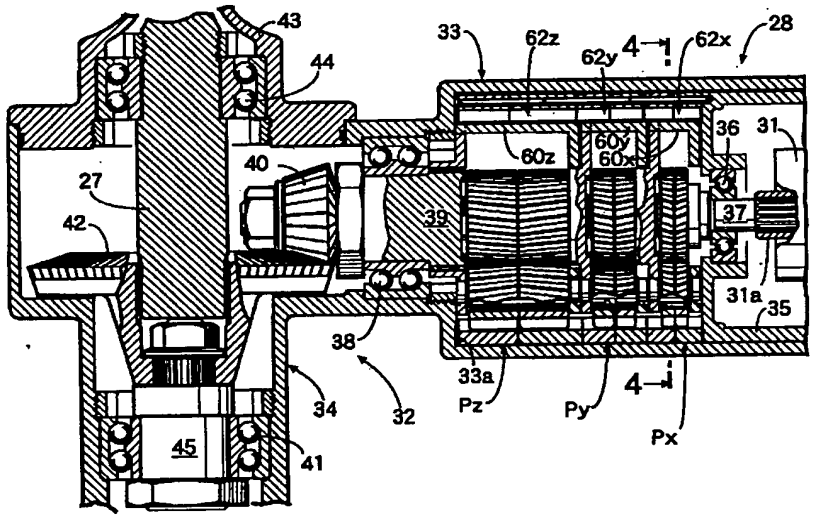
【図８】第３実施例に係る自動車の右後輪のサスペンションの平面図

【図９】図８の９－９線断面図

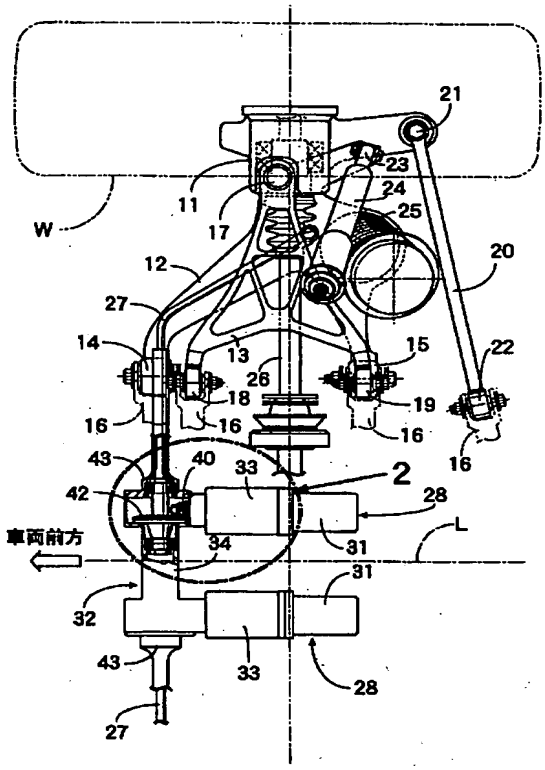
【符号の説明】

W	車輪
１２	ロアアーム（車輪と共に上下動する部材）
２７	トーションバー
２８	アクチュエータ
３１	モータ
７１	アクチュエータ
８６	モータ
８７	ステータ
８８	ロータ

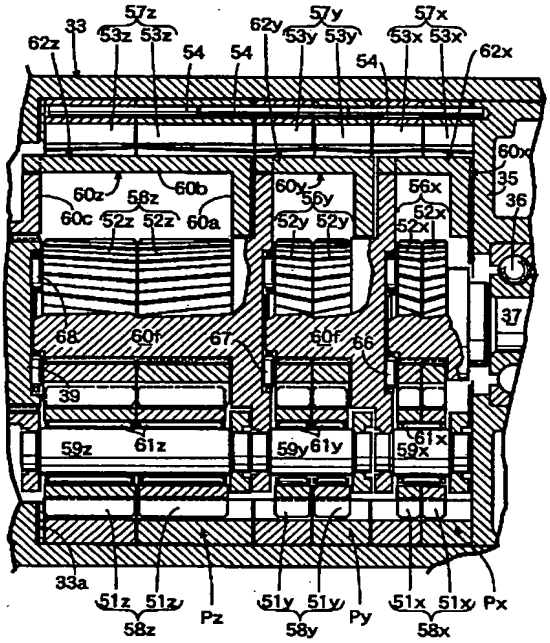
【図２】



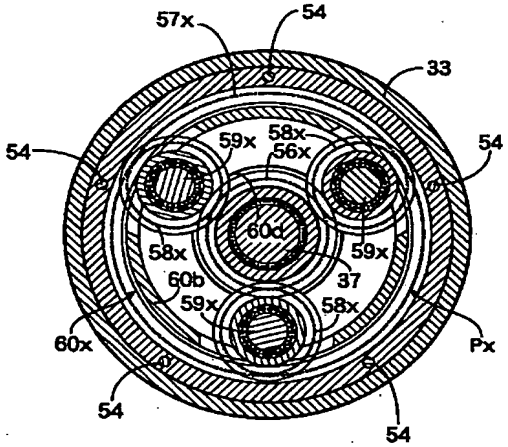
【図１】


W
11
17
21
23
24
25
20
12
27
14
13
15
22
26
18
19
16
16
16
16
43
40
33
2
42
28
車両前方
34
31
L
31
32
43
33
28
27

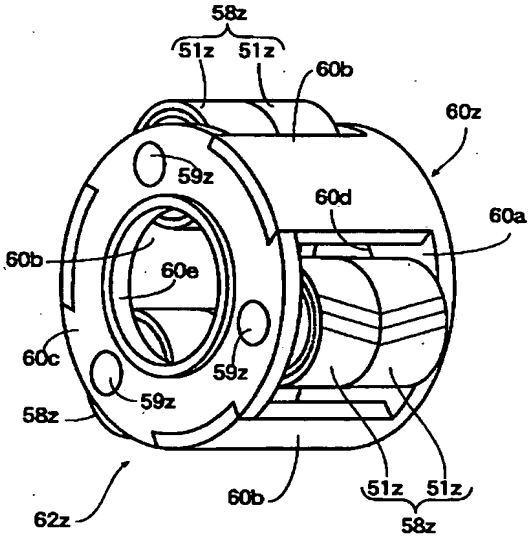
【図３】


57z
57y
57x
62z
33
53z 53z
62y
53y 53y
53x 53x
62x
54
54
54
60x
60z
58z
60b
60y
56y
56x
35
36
60c
52z 52z
60a
52y 52y
52x
52x
37
68
60f
67
60f
66
39
59z
61z
59y
61y
59x
61x
33a
51z 51z
58z
Pz
51y 51y
58y
Py
51x 51x
58x
Px

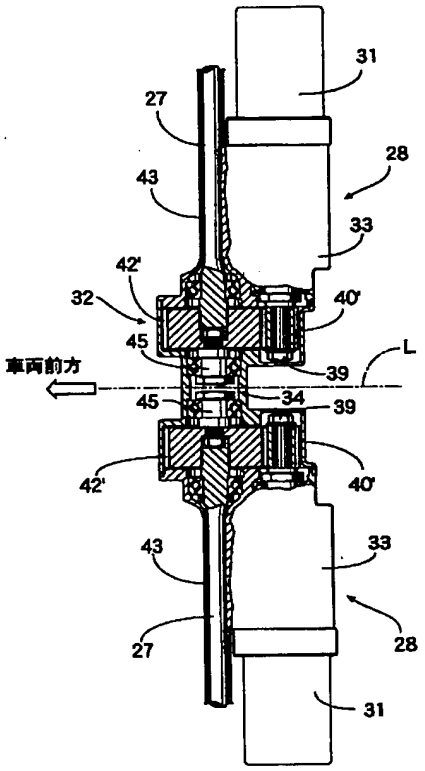
【図４】


57x
54
33
54
59x
58x
56x
54
60d
58x
59x
60b
37
59x
58x
60x
Px
54
54

【図５】


58z
51z 51z
60b
60z
59z
60d
60a
60b
60e
60c
59z
59z
58z
62z
60b
51z 51z
58z

【図６】


31
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42'
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40'
45
車両前方
L
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42'
40'
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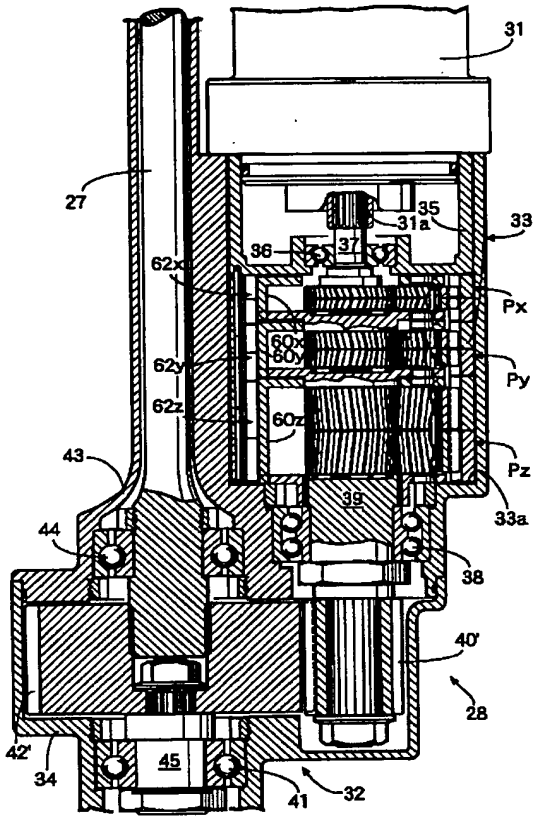
33
27
28
31

【図７】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27
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31a
33
36
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62x
Px
60x
60y
62y
Py
62z
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Pz
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33a
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38
40'
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34
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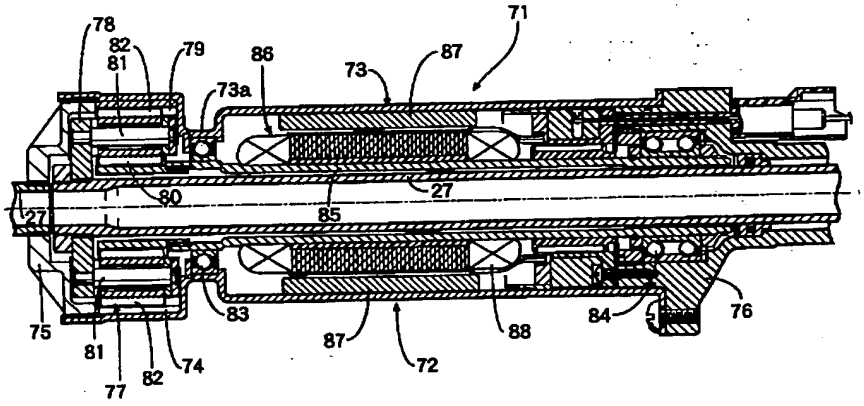
【図９】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87
71
73a
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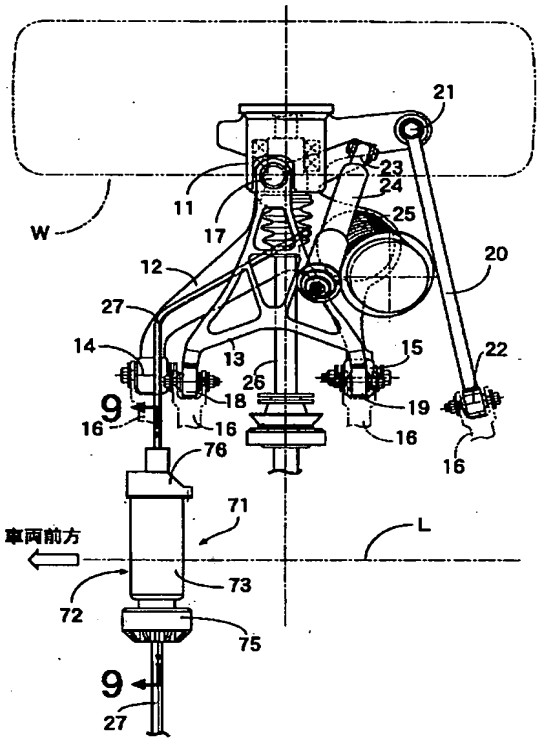
【図８】



フロントページの続き

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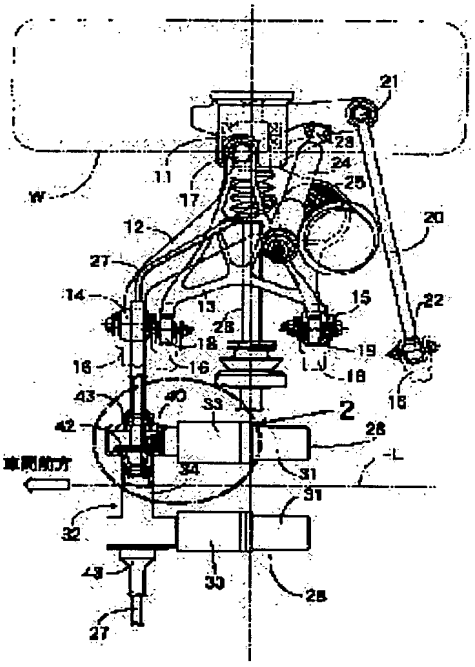
(54) SUSPENSION CONTROL DEVICE OF AUTOMOBILE

(57)Abstract:
PROBLEM TO BE SOLVED: To improve degree of freedom of a mounting position of an actuator for vertically moving a wheel.
SOLUTION: The outer ends of right and left torsion bars 27 are connected to right and left lower arms 12 vertically moving with the right and left wheels W, an inner ends of the torsion bars 27 coaxially facing to each other on both sides of car body center line L are driven by corresponding actuators 28 while being twisted. Driving forces of the actuators 28 vertically move the right and left wheels W via the torsion bars 27, and rolling or pitching can be controlled. The actuators 28 can be disposed in the central part of the car body, so that the actuators 28 hardly interfere with a suspension of the right and left wheels W and degree of freedom of the mounting positions of the actuators 28 can be improved.



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CLAIMS

[Claim(s)]
[Claim 1] The suspension control unit of the automobile characterized by having the actuator (28 71) which carries out the rotation drive of the toe of the torsion bar spring (27) on either side with which a heel is connected to the member (12) which moves up and down with a wheel (W) on either side, and a toe counters the same axle in a car-body center section, and a torsion bar spring (27) on either side respectively.
[Claim 2] Said actuator (28) is a suspension control unit of an automobile according to claim 1 which is equipped with a motor (31) on either side, and is characterized by connecting with one toe of the torsion bar spring (27) of right and left of a motor (31) on either side, and the toe of another side, respectively.
[Claim 3] Said actuator (71) is a suspension control unit of an automobile according to claim 1 which is equipped with a single motor (86) and is characterized by connecting with one toe of the torsion bar spring (27) of right and left of the motor (the stator (87) of 86), and Rota (88), and the toe of another side, respectively.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the suspension control unit of the automobile which moves a wheel on either side up and down through a torsion bar spring with an actuator.
[0002]
[Description of the Prior Art] The suspension control unit which moves a wheel on either side up and down with an actuator is well-known by JP,7-149130,A. This suspension control device has connected to said output shaft near the supporting point which is equipped with the actuator which slows down and outputs rotation of a motor by the moderation device, and links directly the end face of the suspension arm which carries out the suspension of the wheel with the output shaft of an actuator, or supports the end face of a suspension arm through a pinion and sector gear. Therefore, by driving an actuator, a suspension arm is moved up and down positively and improvement in the degree-of-comfort engine performance or driving stability ability can be aimed at.
[0003]
[Problem(s) to be Solved by the Invention] By the way, since the above-mentioned conventional thing needs to form an actuator near the suspension arm, it has the problem on which the degree of freedom of the attaching position of an actuator is restrained sharply.
[0004] This invention was made in view of the above-mentioned situation, and aims at raising the degree of freedom of the attaching position of the actuator which moves a wheel up and down.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, according to invention indicated by claim 1, a heel is connected to the member which moves up and down with a wheel on either side, and the suspension control unit of the automobile characterized by having the actuator which carries out the rotation drive of the toe of the torsion bar spring on either side with which a toe counters the same axle in a car-body center section, and a torsion bar spring on either side respectively is proposed.
[0006] According to the above-mentioned configuration, by making the toe of the torsion bar spring on either side by which the heel was connected to the member moving up and down counter the same axle in a car-body center section, and carrying out a rotation drive respectively with an actuator with a wheel on either side, a wheel on either side is moved up and down through a torsion bar spring with the driving force of an actuator, and control of rolling or pitching can be performed. And since an actuator can be arranged in the car-body center section, an actuator stops easily being able to interfere with the suspension of a wheel on either side, and can raise the degree of freedom of the attaching position of an actuator.
[0007] moreover -- according to invention indicated by claim 2 -- the configuration of claim 1 -- in addition, said actuator is equipped with a motor on either side, and the suspension control unit of the automobile characterized by connecting with one toe of the torsion bar spring of right and left of a motor on either side and the toe of another side, respectively is proposed.
[0008] According to the above-mentioned configuration, since the toe of a torsion bar spring on either side is driven by the motor of right and left of an actuator, respectively, a wheel on either side is moved up and down by in phase, the opposite phase, or independent, and rolling and pitching can be controlled effectively.
[0009] moreover -- according to invention indicated by claim 3 -- the configuration of claim 1 -- in addition, said actuator is equipped with a single motor and the suspension control unit of the automobile characterized by connecting with one toe of the stator of the motor and the torsion bar spring of right and left of Rota and the toe of another side, respectively is proposed.
[0010] According to the above-mentioned configuration, since the toe of a torsion bar spring on either side is driven to hard flow by the single motor, respectively, a wheel on either side is moved up and down by the opposite phase, and rolling can be controlled effectively, and since the number of motors can moreover be managed with one piece, it can contribute to reduction of components mark, weight, and cost.
[0011] In addition, the lower control arm 12 of an example corresponds to the member which moves up and

down with the wheel of this invention.
[0012]
[Embodiment of the Invention] Hereafter, it explains based on the example of this invention which showed the gestalt of operation of this invention to the accompanying drawing.
[0013] Drawing 1 – drawing 5 show the 1st example of this invention, and, for the top view of the suspension of the right rear ring of an automobile, and drawing 2 , 2 section expanded sectional view of drawing 1 and drawing 3 are [drawing 1 / the 4–4 line sectional view of drawing 2 and drawing 5 of the important section enlarged drawing of drawing 2 and drawing 4] the perspective views of a planetary carrier assembly.
[0014] Drawing 1 shows the suspension of the right rear ring of a four–wheel–drive car, and the knuckle 11 which supports Wheel W free [rotation] is supported possible [vertical movement] through the lower control arm 12 and the upper arm 13 of A mold. It connects with the lower part of a knuckle 11 through the swivel joint (not shown) formed at the tip, and a lower control arm 12 is connected to a car body 16 through the rubber bush joint 14 and 15 of the pair prepared in the end face. It connects with the upper part of a knuckle 11 through the swivel joint 17 formed at the tip, and the upper arm 13 is connected to a car body 16 through the rubber bush joint 18 and 19 of the pair prepared in the end face. Furthermore, the posterior part and car body 16 of a knuckle 11 are connected through the lateral link 20 and two rubber bush joint 21 and 22. Moreover, the lower limit of a shock absorber 24 is connected to the rubber bush joint 23 formed in the tip side of a lower control arm 12, and the lower limit of a suspension spring 25 is supported by the spring seat prepared in the center of a lower control arm 12. The drive shaft 26 which transmits engine driving force penetrates a knuckle 11, and is connected to Wheel W.
[0015] "–– passing –– " –– the heel of a part where the torsion bar spring 27 formed in the shape of a character is prolonged in middle flection empty vehicle outside–of–the–body side back was connected with the lower control arm 12, and the toe of the part prolonged in a middle flection empty vehicle inside–of–the–body side has extended to near the car–body center line L. Therefore, the toe of the torsion bar springs 27 and 27 on either side has countered the same axle on both sides of the car–body center line L, and the actuators 28 and 28 on either side are arranged between the opposite section. The actuators 28 and 28 on either side have symmetrical structure on both sides of the car–body center line L, and they carry out a rotation drive so that the toe of the torsion bar spring 27 with which each actuator 28 corresponds may be twisted.
[0016] A deer is carried out, a knuckle 11 moves up and down with Wheel W with transit of a car, the shock absorber 24 and suspension spring 25 which were connected to the lower control arm 12 when it moved up and down as the supporting point expand and contract the end face by which the lower control arm 12 and the upper arm 13 which were connected to the knuckle 11 were supported by the car body 16, and vertical movement of Wheel W is buffered. And if it is made to rotate so that an actuator 28 may be driven and the toe of a torsion bar spring 27 may be twisted, the lower control arm 12 connected to the heel of the torsion bar spring 27 will move up and down. Therefore, rolling and pitching of a car are positively controllable by driving the actuators 28 and 28 corresponding to the wheels W and W on either side in relation to mutual, respectively.
[0017] Next, the structure of an actuator 28 is explained based on drawing 2 – drawing 5 .
[0018] The actuator 28 consists of a motor 31 and a reduction gearbox 32, and a reduction gearbox 32 is equipped with the 1st housing 33 and 33 of a Uichi Hidari pair prolonged in a car–body cross direction, and the 2nd housing 34 which connects between the front end of the 1st housing 33 and 33 on either side, and is prolonged in a car–body longitudinal direction. The 1st housing 33 is an outline cylinder–like member, and a motor 31 is combined with the back end by the same axle. The input shaft 37 is supported through the ball bearing 36 by the cup–like electrode holder 35 inserted from back end opening of the 1st housing 33, and spline association of the back end of this input shaft 37 is carried out at revolving–shaft 31a of a motor 31. Although a torsion bar spring 27 will receive a bending load by vertical movement of Wheel W since a reduction gearbox 32 is fixed to the rear subframe of a car body, the bending load is absorbed by the elastic deformation of a torsion bar spring 27.
[0019] Rotation of an input shaft 37 is slowed down through the three–set epicyclic gear devices Px, Py, and Pz contained inside the 1st housing 33, and is outputted to the output shaft 39 supported by the front end of the 1st housing 33 by the ball bearing 38. Although the three–set epicyclic gear devices Px, Py, and Pz are arranged at a serial and are substantially equipped with the same structure on the same axle, the width of face of the shaft orientations is carrying out the sequential increment toward the output side from the input side. Since transfer torque increases by moderation, the reason is for making the thickness of a gear increase so that the transfer torque may be borne.
[0020] First, the structure of the 3rd epicyclic gear device Pz of an output side is explained. The 3rd epicyclic gear device Pz is equipped with sun gear 56z, ring wheel 57z, and three planetary–gear 58z––, three planetary–gear shafts 59z––, and planetary carrier 60z. Planetary carrier 60z is equipped with disc–like 2nd side plate 60c of leg 60b–– combined at a tip with disc–like 1st side plate 60a and three leg 60b–– prolonged in shaft orientations at intervals of 120 degrees from the periphery of 1st side plate 60a, and the respectively circular

openings 60d and 60e are formed in the center of 1st side plate 60a and 2nd side plate 60c. Three planetary-gear shafts 59z -- Both ends are being fixed to 1st side plate 60a and 2nd side plate 60c, respectively, and planetary-gear 58z-- is supported by these planetary-gear shaft 59z-- through needle bearings 61z and 61z. It has projected outside from leg of planetary-gear 58z-- which part adjoins 60b--, and opening surrounded by the side plates 60a and 60c of a pair. These planetary carrier 60z and three planetary-gear shafts 59z-- and planetary-gear 58z-- are beforehand assembled as 3rd planetary carrier assembly 62z (refer to drawing 5).

[0021] Each planetary-gear 58z of the 3rd epicyclic gear device Pz is constituted combining the gear half objects 51z and 51z of a pair with which the twist direction changes mutually from a reverse helical gear back to back. By using it, using the same components for the gear half objects 51z and 51z of a pair, and reversing the front flesh side of one of these Planetary carrier 60y of the 2nd epicyclic gear device Py which the class of components can be decreased and can reduce cost Instead of opening 60e (refer to drawing 5) formed in side plate 60c of planetary carrier 60z of the 3rd epicyclic gear device Pz, it has 60f (refer to drawing 3) of sun gear shafts which project from the center section of side plate 60c. Sun gear 56z of the 3rd epicyclic gear device Pz by which spline association is carried out is constituted back to back by 60f of said sun gear shafts combining the gear half objects 52z and 52z of a pair with which the twist direction consists mutually of a reverse helical gear. The twist direction is constituted combining the gear half objects 53z and 53z of the pair which consists mutually of a reverse helical gear back to back, it fits into the inner circumference of the 1st housing 33, and ring wheel 57z of the 3rd epicyclic gear device Pz is a pin 54. -- A baffle is carried out and it is fixed to shaft orientations in contact with step 33a of the 1st housing 33. By using it, constituting the gear half objects 52z and 52z of the pair of sun gear 56z from same components, and reversing one front flesh side The class of components can be decreased, cost can be reduced, by using it, constituting the gear half objects 53z and 53z of the pair of ring wheel 57z from same components similarly, and reversing one front flesh side, the class of components can be decreased and cost can be reduced.

[0022] The structure of the 1st epicyclic gear device Px and the 2nd epicyclic gear device Py is substantially [as the structure of the 3rd epicyclic gear device Pz] the same, and the sign changes the subscript z of the sign of the component of the 3rd epicyclic gear device Pz into x and y, respectively. Moreover, although spline association of the sun gears 56y and 56z of the 2nd and 3rd epicyclic gear devices Py and Pz is carried out at the sun gear shafts 60f and 60f prepared in the planetary carriers 60x and 60y, sun gear 56x of the 1st epicyclic gear device Px are formed in an input shaft 37 at one.

[0023] the 1st -- thrust bearing 66 is arranged between sun gear 56x and planetary carrier 60x insides of planetary carrier assembly 62x, thrust bearing 67 is arranged between sun gear 56y and the planetary carrier 60y insides of 2nd planetary carrier assembly 62y, thrust bearing 68 is arranged between sun gear 56z and the output shafts 39 of 3rd planetary carrier assembly 62z, and spline association of the 3rd planetary carrier assembly 62z is carried out at an output shaft 39. And 58z-- gears to planetary-gear 58x -- of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz, and 58y--, the sun gears 56x, 56y, and 56z which correspond, respectively and ring wheels 57x, 57y, and 57z.

[0024] It has geared to the follower bevel gear 42 which the drive bevel gear 40 prepared in the front end of an output shaft 39 fixed to the gear shaft 45 supported through the ball bearing 41 in the 2nd housing 34, and spline association of the toe of a torsion bar spring 27 is carried out at the follower bevel gear 42. The range of predetermined [the toe of a torsion bar spring 27 to] is covered with the covering 43 combined with the opening edge of the 2nd housing 34, and is supported by the ball bearing 44.

[0025] If it ** and a motor 31 is driven, rotation of the revolving-shaft 31a will be transmitted to sun gear 56x of the 1st epicyclic gear device Px through an input shaft 37. then -- while planetary-gear 58x -- which gears to sun gear 56x rotating and ring wheel 57x stopped rotates to the circumference of planetary-gear shaft 59x -- the 1st -- planetary carrier assembly 62x are slowed down rather than sun gear 56x, and rotate. thus, the 1st -- if planetary carrier assembly 62x rotate -- the rotation -- the 1st -- it is transmitted to 60f of sun gear shafts of planetary carrier assembly 62x at sun gear 56y of the 2nd epicyclic gear device Py by which spline association was carried out.

[0026] Rotation of sun gear 56y of the 2nd epicyclic gear device Py is slowed down, and is outputted to 2nd planetary carrier assembly 62y, and the rotation of sun gear 56z of the 3rd epicyclic gear device Pz used as 60f of sun gear shafts of 2nd planetary carrier assembly 62y spline joint 70 is slowed down, and is outputted to 3rd planetary carrier assembly 62z. Consequently, the output shaft 39 by which spline association was carried out rotates to 3rd planetary carrier assembly 62z. An output shaft 39 makes it rotate so that rotation may be transmitted to the toe of a torsion bar spring 27 through the drive bevel gear 40 and the follower bevel gear 42 and may twist the toe according to the hand of cut of a motor 21.

[0027] Therefore, since the lower control arms 12 and 12 on either side can be made to be able to rock up and down through the torsion bar springs 27 and 27 on either side and the wheels W and W on either side can be moved up and down to an opposite phase, when rolling of a car is detected, it becomes possible to control the rolling. Moreover, it is also possible to move the wheels W and W on either side up and down in phase, the

property of a shock absorber 24 or a suspension spring 25 can be changed by this, and pitching moment control and skyhook control can be realized.
[0028] Since the three-set epicyclic gear devices Px, Py, and Pz were connected to the serial inside this kind and a reduction gearbox 32, a big reduction gear ratio can be secured with compact structure, and a torsion bar spring 27 can be certainly driven with big torque. Moreover, since the actuators 28 and 28 on either side are arranged near the car-body center line L, it can avoid that actuators 28 and 28 interfere with a suspension on either side, and the degree of freedom of a layout can be made to increase sharply.
[0029] Moreover, the planetary carrier assemblies 62x, 62y, and 62z of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz Since it is combined with one by three leg 60b-- and the side plates 60a and 60c of the pair of the planetary carriers 60x, 60y, and 60z have box-like structure, It becomes possible to raise rigidity sharply compared with the conventional thing which combined the side plate of a pair only with three planetary-gear shafts, and decline in the torque transmission efficiency by distortion of the planetary carriers 60x, 60y, and 60z and the fall of the endurance by wear of the engagement section of each gear can be prevented.
[0030] Moreover, the sun gears 56x, 56y, and 56z of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz, Planetary-gear 58x --, 58y--, and 58z-- and ring wheels 57x, 57y, and 57z Since the twist direction is constituted combining the gear half objects 51x-51z of the pair which changes mutually from a reverse helical gear, 52x-52z, and 53x-53z back to back Generating of the thrust force which is the demerit of a helical gear is mitigable, employing the advantage of a helical gear with the small engagement noise efficiently as it is. That is, when generating the thrust force in which both helical gears push one another mutually when the twist direction combines the helical gear of a reverse pair mutually, these thrust force can be offset completely. Moreover, when generating the thrust force of a direction in which both helical gears desert mutually, a 2-way can be made to be able to distribute these thrust force, and one half can be decreased substantially. Thereby, the thrust bearings 66-68 which support said thrust force can be miniaturized or abolished.
[0031] Moreover, instead of the twist direction combining the helical gear of a reverse pair mutually, even if it adopts a **** gear (double helical gear), the same effectiveness can be acquired. However, a **** gear has troublesome processing and has the problem on which cost increases, and the helical gear of this example is easy to process it to it, and it is low cost. And since 52z-- gears with planetary-gear 58x --, 58y--, all gear half object 52x-- of 58z--, and 52y-- to both sun gears 56x, 56y, and 56z and the ring wheels 57x, 57y, and 57z Planetary-gear 58x --, 58y, --, 58z -- Torque-transmission capacity can be raised compared with gear half object 52x --, 52y--, and the case where 52z-- meshes sun gears 56x, 56y, and 56z and ring wheels 57x, 57y, and 57z only to either.
[0032] Next, the 2nd example of this invention is explained based on drawing 6 and drawing 7 .
[0033] Although the motor 31 and the 1st housing 33 of an actuator 28 are arranged in the 1st example at the car-body cross direction, it differs in the 2nd example in that car-body longitudinal-direction arrangement of the motor 31 and the 1st housing 33 of an actuator 28 is carried out along with the posterior part of a torsion bar spring 27. Although the structure of the 1st contained by the 1st housing 33 - the 3rd epicyclic gear devices Px, Py, and Pz is the same as that of the thing of the 1st example, the structure of transmitting rotation of an output shaft 39 to a torsion bar spring 27 is changed according to modification of the orientation of the 1st housing 33.
[0034] That is, in the 1st example, since the output shaft 39 and the toe of a torsion bar spring 27 lay at right angles, rotation of an output shaft 39 was transmitted to the torsion bar spring 27 through the drive bevel gear 40 and the follower bevel gear 42, but in the 2nd example, since the output shaft 39 and the toe of a torsion bar spring 27 are parallel, rotation of an output shaft 39 is transmitted to the torsion bar spring 27 through drive spur-gear 40' and follower spur-gear 42'. A deer can be carried out and the same operation effectiveness as the 1st example can be done so also by this example.
[0035] Next, the 3rd example of this invention is explained based on drawing 8 and drawing 9 .
[0036] To the 1st and 2nd example being equipped with the actuators 28 and 28 of a Uichi Hidari pair corresponding to the wheels W and W on either side, the 3rd example is equipped with the single actuator 71 corresponding to the wheels W and W on either side, and the torsion bar springs 27 and 27 on either side are mutually twisted to hard flow with this actuator 71.
[0037] The housing 72 of an actuator 71 is equipped with the outline cylinder-like housing body 73 with which narrow diameter portion 73a was formed in the location of the central left, the left covering 75 which is combined with the left end section of the housing body 73, and divides the epicyclic gear device receipt room 74, and the right covering 76 combined with the right end section of the housing body 73. The right-hand side torsion bar spring 27 penetrated the interior of housing 72, the toe has extended inside the epicyclic gear device receipt room 74, and the toe of the left-hand side torsion bar spring 27 is being fixed to the left covering 75 of housing 72.
[0038] The epicyclic gear device 77 contained inside the epicyclic gear device receipt room 74 The planetary carrier 78, a ring wheel 79, a sun gear 80, and two or more pinion shaft 81 --, Consist of two or more pinion 82 -

-, and the planetary carrier 78 is fixed to the toe of the right-hand side torsion bar spring 27. A ring wheel 79 is fixed to the housing body 73, and the sun gear 80 is being fixed to the tubed revolving shaft 85 supported by the housing body 73 and the right covering 76 by ball bearings 83 and 84. Pinion 82 -- supported by pinion shaft 81 -- fixed to the planetary carrier 78 gears to a ring wheel 79 and a sun gear 80 at coincidence.
[0039] The motor 86 contained by the housing body 73 is equipped with the stator 87 which consists of a permanent magnet fixed to the inner skin of the housing body 73, and Rota 88 which consists of a coil fixed to the periphery of a revolving shaft 85.
[0040] Therefore, if a motor 86 is driven, Rota 88 will rotate to a stator 87, and rotation of Rota 88 is inputted into the sun gear 80 which is the input member of the epicyclic gear device 77 through a revolving shaft 85, is outputted from the planetary carrier 78 which is the output member, and gives torsion of an one direction to the toe of the right-hand side torsion bar spring 27. Consequently, it is transmitted to the left-hand side torsion bar spring 27 through the housing body 73 and the left covering 75 from the stator 87 of a motor 86, and the reaction force of the torsion load of the right-hand side torsion bar spring 27 is contrary to the right-hand side torsion bar spring 27 to the toe of the torsion bar spring 27, and also receives torsion of a direction. Consequently, the torsion bar springs 27 and 27 on either side are mutually twisted to hard flow with equal torque, and can generate the desired roll moment by pushing up one side of the wheels W and W on either side, and depressing another side.
[0041] Since an actuator 71 can be arranged near the car-body center line L, it can avoid that an actuator 71 interferes with a suspension on either side, and the degree of freedom of a layout can be made to increase sharply also by this example. And since the wheels W and W on either side can be moved up and down with the single actuator 71, compared with the 1st and 2nd example, structure becomes easy, and components mark and cost can be reduced further.
[0042] As mentioned above, although the example of this invention was explained in full detail, this invention can perform design changes various in the range which does not deviate from the summary.
[0043] For example, although the longitudinal-direction heel of torsion bar springs 27 and 27 is connected to lower control arms 12 and 12 in the example, it is connectable with the member (for example, the upper arms 13 and 13 and knuckles 11 and 11) which moves up and down with Wheels W and W. Moreover, although this invention is applied to the suspension of a rear wheel in the example, it is also possible to apply it to the suspension of a front wheel.
[0044]
[Effect of the Invention] According to invention indicated by claim 1 as mentioned above, by making the toe of the torsion bar spring on either side by which the heel was connected to the member which moves up and down with a wheel on either side counter the same axle in a car-body center section, and carrying out a rotation drive respectively with an actuator, a wheel on either side is moved up and down through a torsion bar spring with the driving force of an actuator, and control of rolling or pitching can be performed. And since an actuator can be arranged in the car-body center section, an actuator stops easily being able to interfere with the suspension of a wheel on either side, and can raise the degree of freedom of the attaching position of an actuator.
[0045] Moreover, according to invention indicated by claim 2, since the toe of a torsion bar spring on either side is driven by the motor of right and left of an actuator, respectively, a wheel on either side is moved up and down by in phase, the opposite phase, or independent, and rolling and pitching can be controlled effectively.
[0046] Moreover, according to invention indicated by claim 3, since the toe of a torsion bar spring on either side is driven to hard flow by the single motor, respectively, a wheel on either side is moved up and down by the opposite phase, and rolling can be controlled effectively, and since the number of motors can moreover be managed with one piece, it can contribute to reduction of components mark, weight, and cost.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the suspension control unit of the automobile which moves a wheel on either side up and down through a torsion bar spring with an actuator.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The suspension control unit which moves a wheel on either side up and down with an actuator is well-known by JP,7-149130,A. This suspension control device has connected to said output shaft near the supporting point which is equipped with the actuator which slows down and outputs rotation of a motor by the moderation device, and links directly the end face of the suspension arm which carries out the suspension of the wheel with the output shaft of an actuator, or supports the end face of a suspension arm through a pinion and sector gear. Therefore, by driving an actuator, a suspension arm is moved up and down positively and improvement in the degree-of-comfort engine performance or driving stability ability can be aimed at.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to invention indicated by claim 1 as mentioned above, by making the toe of the torsion bar spring on either side by which the heel was connected to the member which moves up and down with a wheel on either side counter the same axle in a car-body center section, and carrying out a rotation drive respectively with an actuator, a wheel on either side is moved up and down through a torsion bar spring with the driving force of an actuator, and control of rolling or pitching can be performed. And since an actuator can be arranged in the car-body center section, an actuator stops easily being able to interfere with the suspension of a wheel on either side, and can raise the degree of freedom of the attaching position of an actuator.
[0045] Moreover, according to invention indicated by claim 2, since the toe of a torsion bar spring on either side is driven by the motor of right and left of an actuator, respectively, a wheel on either side is moved up and down by in phase, the opposite phase, or independent, and rolling and pitching can be controlled effectively.
[0046] Moreover, according to invention indicated by claim 3, since the toe of a torsion bar spring on either side is driven to hard flow by the single motor, respectively, a wheel on either side is moved up and down by the opposite phase, and rolling can be controlled effectively, and since the number of motors can moreover be managed with one piece, it can contribute to reduction of components mark, weight, and cost.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, since the above-mentioned conventional thing needs to form an actuator near the suspension arm, it has the problem on which the degree of freedom of the attaching position of an actuator is restrained sharply.
[0004] This invention was made in view of the above-mentioned situation, and aims at raising the degree of freedom of the attaching position of the actuator which moves a wheel up and down.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, according to invention indicated by claim 1, a heel is connected to the member which moves up and down with a wheel on either side, and the suspension control unit of the automobile characterized by having the actuator which carries out the rotation drive of the toe of the torsion bar spring on either side with which a toe counters the same axle in a car-body center section, and a torsion bar spring on either side respectively is proposed.
[0006] According to the above-mentioned configuration, by making the toe of the torsion bar spring on either side by which the heel was connected to the member moving up and down counter the same axle in a car-body center section, and carrying out a rotation drive respectively with an actuator with a wheel on either side, a wheel on either side is moved up and down through a torsion bar spring with the driving force of an actuator, and control of rolling or pitching can be performed. And since an actuator can be arranged in the car-body center section, an actuator stops easily being able to interfere with the suspension of a wheel on either side, and can raise the degree of freedom of the attaching position of an actuator.
[0007] moreover -- according to invention indicated by claim 2 -- the configuration of claim 1 -- in addition, said actuator is equipped with a motor on either side, and the suspension control unit of the automobile characterized by connecting with one toe of the torsion bar spring of right and left of a motor on either side and the toe of another side, respectively is proposed.
[0008] According to the above-mentioned configuration, since the toe of a torsion bar spring on either side is driven by the motor of right and left of an actuator, respectively, a wheel on either side is moved up and down by in phase, the opposite phase, or independent, and rolling and pitching can be controlled effectively.
[0009] moreover -- according to invention indicated by claim 3 -- the configuration of claim 1 -- in addition, said actuator is equipped with a single motor and the suspension control unit of the automobile characterized by connecting with one toe of the stator of the motor and the torsion bar spring of right and left of Rota and the toe of another side, respectively is proposed.
[0010] According to the above-mentioned configuration, since the toe of a torsion bar spring on either side is driven to hard flow by the single motor, respectively, a wheel on either side is moved up and down by the opposite phase, and rolling can be controlled effectively, and since the number of motors can moreover be managed with one piece, it can contribute to reduction of components mark, weight, and cost.
[0011] In addition, the lower control arm 12 of an example corresponds to the member which moves up and down with the wheel of this invention.
[0012]
[Embodiment of the Invention] Hereafter, it explains based on the example of this invention which showed the gestalt of operation of this invention to the accompanying drawing.
[0013] Drawing 1 - drawing 5 show the 1st example of this invention, and, for the top view of the suspension of the right rear ring of an automobile, and drawing 2 , 2 section expanded sectional view of drawing 1 and drawing 3 are [drawing 1 / the 4-4 line sectional view of drawing 2 and drawing 5 of the important section enlarged drawing of drawing 2 and drawing 4] the perspective views of a planetary carrier assembly.
[0014] Drawing 1 shows the suspension of the right rear ring of a four-wheel-drive car, and the knuckle 11 which supports Wheel W free [rotation] is supported possible [vertical movement] through the lower control arm 12 and the upper arm 13 of A mold. It connects with the lower part of a knuckle 11 through the swivel joint (not shown) formed at the tip, and a lower control arm 12 is connected to a car body 16 through the rubber bush joint 14 and 15 of the pair prepared in the end face. It connects with the upper part of a knuckle 11 through the swivel joint 17 formed at the tip, and the upper arm 13 is connected to a car body 16 through the rubber bush joint 18 and 19 of the pair prepared in the end face. Furthermore, the posterior part and car body 16 of a knuckle 11 are connected through the lateral link 20 and two rubber bush joint 21 and 22. Moreover, the lower limit of a shock absorber 24 is connected to the rubber bush joint 23 formed in the tip side of a lower control arm 12, and the lower limit of a suspension spring 25 is supported by the spring seat prepared in the center of a lower control arm 12. The drive shaft 26 which transmits engine driving force penetrates a knuckle 11, and is connected to Wheel W.

[0015] "-- passing -- " -- the heel of a part where the torsion bar spring 27 formed in the shape of a character is prolonged in middle flection empty vehicle outside-of-the-body side back was connected with the lower control arm 12, and the toe of the part prolonged in a middle flection empty vehicle inside-of-the-body side has extended to near the car-body center line L. Therefore, the toe of the torsion bar springs 27 and 27 on either side has countered the same axle on both sides of the car-body center line L, and the actuators 28 and 28 on either side are arranged between the opposite section. The actuators 28 and 28 on either side have symmetrical structure on both sides of the car-body center line L, and they carry out a rotation drive so that the toe of the torsion bar spring 27 with which each actuator 28 corresponds may be twisted.
[0016] A deer is carried out, a knuckle 11 moves up and down with Wheel W with transit of a car, the shock absorber 24 and suspension spring 25 which were connected to the lower control arm 12 when it moved up and down as the supporting point expand and contract the end face by which the lower control arm 12 and the upper arm 13 which were connected to the knuckle 11 were supported by the car body 16, and vertical movement of Wheel W is buffered. And if it is made to rotate so that an actuator 28 may be driven and the toe of a torsion bar spring 27 may be twisted, the lower control arm 12 connected to the heel of the torsion bar spring 27 will move up and down. Therefore, rolling and pitching of a car are positively controllable by driving the actuators 28 and 28 corresponding to the wheels W and W on either side in relation to mutual, respectively.
[0017] Next, the structure of an actuator 28 is explained based on drawing 2 - drawing 5 .
[0018] The actuator 28 consists of a motor 31 and a reduction gearbox 32, and a reduction gearbox 32 is equipped with the 1st housing 33 and 33 of a Uichi Hidari pair prolonged in a car-body cross direction, and the 2nd housing 34 which connects between the front end of the 1st housing 33 and 33 on either side, and is prolonged in a car-body longitudinal direction. The 1st housing 33 is an outline cylinder-like member, and a motor 31 is combined with the back end by the same axle. The input shaft 37 is supported through the ball bearing 36 by the cup-like electrode holder 35 inserted from back end opening of the 1st housing 33, and spline association of the back end of this input shaft 37 is carried out at revolving-shaft 31a of a motor 31. Although a torsion bar spring 27 will receive a bending load by vertical movement of Wheel W since a reduction gearbox 32 is fixed to the rear subframe of a car body, the bending load is absorbed by the elastic deformation of a torsion bar spring 27.
[0019] Rotation of an input shaft 37 is slowed down through the three-set epicyclic gear devices Px, Py, and Pz contained inside the 1st housing 33, and is outputted to the output shaft 39 supported by the front end of the 1st housing 33 by the ball bearing 38. Although the three-set epicyclic gear devices Px, Py, and Pz are arranged at a serial and are substantially equipped with the same structure on the same axle, the width of face of the shaft orientations is carrying out the sequential increment toward the output side from the input side. Since transfer torque increases by moderation, the reason is for making the thickness of a gear increase so that the transfer torque may be borne.
[0020] First, the structure of the 3rd epicyclic gear device Pz of an output side is explained. The 3rd epicyclic gear device Pz is equipped with sun gear 56z, ring wheel 57z, and three planetary-gear 58z--, three planetary-gear shafts 59z--, and planetary carrier 60z. Planetary carrier 60z is equipped with disc-like 2nd side plate 60c of leg 60b-- combined at a tip with disc-like 1st side plate 60a and three leg 60b-- prolonged in shaft orientations at intervals of 120 degrees from the periphery of 1st side plate 60a, and the respectively circular openings 60d and 60e are formed in the center of 1st side plate 60a and 2nd side plate 60c. Three planetary-gear shafts 59z -- Both ends are being fixed to 1st side plate 60a and 2nd side plate 60c, respectively, and planetary-gear 58z-- is supported by these planetary-gear shaft 59z-- through needle bearings 61z and 61z. It has projected outside from leg of planetary-gear 58z-- which part adjoins 60b--, and opening surrounded by the side plates 60a and 60c of a pair. These planetary carrier 60z and three planetary-gear shafts 59z-- and planetary-gear 58z-- are beforehand assembled as 3rd planetary carrier assembly 62z (refer to drawing 5).
[0021] Each planetary-gear 58z of the 3rd epicyclic gear device Pz is constituted combining the gear half objects 51z and 51z of a pair with which the twist direction changes mutually from a reverse helical gear back to back. By using it, using the same components for the gear half objects 51z and 51z of a pair, and reversing the front flesh side of one of these Planetary carrier 60y of the 2nd epicyclic gear device Py which the class of components can be decreased and can reduce cost Instead of opening 60e (refer to drawing 5) formed in side plate 60c of planetary carrier 60z of the 3rd epicyclic gear device Pz, it has 60f (refer to drawing 3) of sun gear shafts which project from the center section of side plate 60c. Sun gear 56z of the 3rd epicyclic gear device Pz by which spline association is carried out is constituted back to back by 60f of said sun gear shafts combining the gear half objects 52z and 52z of a pair with which the twist direction consists mutually of a reverse helical gear. The twist direction is constituted combining the gear half objects 53z and 53z of the pair which consists mutually of a reverse helical gear back to back, it fits into the inner circumference of the 1st housing 33, and ring wheel 57z of the 3rd epicyclic gear device Pz is a pin 54. -- A baffle is carried out and it is fixed to shaft orientations in contact with step 33a of the 1st housing 33. By using it, constituting the gear half objects 52z and 52z of the pair of sun gear 56z from same components, and reversing one front flesh side The class of

components can be decreased, cost can be reduced, by using it, constituting the gear half objects 53z and 53z of the pair of ring wheel 57z from same components similarly; and reversing one front flesh side, the class of components can be decreased and cost can be reduced.
[0022] The structure of the 1st epicyclic gear device Px and the 2nd epicyclic gear device Py is substantially [as the structure of the 3rd epicyclic gear device Pz] the same, and the sign changes the subscript z of the sign of the component of the 3rd epicyclic gear device Pz into x and y, respectively. Moreover, although spline association of the sun gears 56y and 56z of the 2nd and 3rd epicyclic gear devices Py and Pz is carried out at the sun gear shafts 60f and 60f prepared in the planetary carriers 60x and 60y, sun gear 56x of the 1st epicyclic gear device Px are formed in an input shaft 37 at one.
[0023] the 1st -- thrust bearing 66 is arranged between sun gear 56x and planetary carrier 60x insides of planetary carrier assembly 62x, thrust bearing 67 is arranged between sun gear 56y and the planetary carrier 60y insides of 2nd planetary carrier assembly 62y, thrust bearing 68 is arranged between sun gear 56z and the output shafts 39 of 3rd planetary carrier assembly 62z, and spline association of the 3rd planetary carrier assembly 62z is carried out at an output shaft 39. And 58z-- gears to planetary-gear 58x -- of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz, and 58y--, the sun gears 56x, 56y, and 56z which correspond, respectively and ring wheels 57x, 57y, and 57z.
[0024] It has geared to the follower bevel gear 42 which the drive bevel gear 40 prepared in the front end of an output shaft 39 fixed to the gear shaft 45 supported through the ball bearing 41 in the 2nd housing 34, and spline association of the toe of a torsion bar spring 27 is carried out at the follower bevel gear 42. The range of predetermined [the toe of a torsion bar spring 27 to] is covered with the covering 43 combined with the opening edge of the 2nd housing 34, and is supported by the ball bearing 44.
[0025] If it ** and a motor 31 is driven, rotation of the revolving-shaft 31a will be transmitted to sun gear 56x of the 1st epicyclic gear device Px through an input shaft 37. then -- while planetary-gear 58x -- which gears to sun gear 56x rotating and ring wheel 57x stopped rotates to the circumference of planetary-gear shaft 59x -- the 1st -- planetary carrier assembly 62x are slowed down rather than sun gear 56x, and rotate. thus, the 1st -- if planetary carrier assembly 62x rotate -- the rotation -- the 1st -- it is transmitted to 60f of sun gear shafts of planetary carrier assembly 62x at sun gear 56y of the 2nd epicyclic gear device Py by which spline association was carried out.
[0026] Rotation of sun gear 56y of the 2nd epicyclic gear device Py is slowed down, and is outputted to 2nd planetary carrier assembly 62y, and the rotation of sun gear 56z of the 3rd epicyclic gear device Pz used as 60f of sun gear shafts of 2nd planetary carrier assembly 62y spline joint 70 is slowed down, and is outputted to 3rd planetary carrier assembly 62z. Consequently, the output shaft 39 by which spline association was carried out rotates to 3rd planetary carrier assembly 62z. An output shaft 39 makes it rotate so that rotation may be transmitted to the toe of a torsion bar spring 27 through the drive bevel gear 40 and the follower bevel gear 42 and may twist the toe according to the hand of cut of a motor 21.
[0027] Therefore, since the lower control arms 12 and 12 on either side can be made to be able to rock up and down through the torsion bar springs 27 and 27 on either side and the wheels W and W on either side can be moved up and down to an opposite phase, when rolling of a car is detected, it becomes possible to control the rolling. Moreover, it is also possible to move the wheels W and W on either side up and down in phase, the property of a shock absorber 24 or a suspension spring 25 can be changed by this, and pitching moment control and skyhook control can be realized.
[0028] Since the three-set epicyclic gear devices Px, Py, and Pz were connected to the serial inside this kind and a reduction gearbox 32, a big reduction gear ratio can be secured with compact structure, and a torsion bar spring 27 can be certainly driven with big torque. Moreover, since the actuators 28 and 28 on either side are arranged near the car-body center line L, it can avoid that actuators 28 and 28 interfere with a suspension on either side, and the degree of freedom of a layout can be made to increase sharply.
[0029] Moreover, the planetary carrier assemblies 62x, 62y, and 62z of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz Since it is combined with one by three leg 60b-- and the side plates 60a and 60c of the pair of the planetary carriers 60x, 60y, and 60z have box-like structure, It becomes possible to raise rigidity sharply compared with the conventional thing which combined the side plate of a pair only with three planetary-gear shafts, and decline in the torque transmission efficiency by distortion of the planetary carriers 60x, 60y, and 60z and the fall of the endurance by wear of the engagement section of each gear can be prevented.
[0030] Moreover, the sun gears 56x, 56y, and 56z of the 1st - the 3rd epicyclic gear devices Px, Py, and Pz, Planetary-gear 58x --, 58y--, and 58z-- and ring wheels 57x, 57y, and 57z Since the twist direction is constituted combining the gear half objects 51x-51z of the pair which changes mutually from a reverse helical gear, 52x-52z, and 53x-53z back to back Generating of the thrust force which is the demerit of a helical gear is mitigable, employing the advantage of a helical gear with the small engagement noise efficiently as it is. That is, when generating the thrust force in which both helical gears push one another mutually when the twist direction combines the helical gear of a reverse pair mutually, these thrust force can be offset completely. Moreover,

when generating the thrust force of a direction in which both helical gears desert mutually, a 2-way can be made to be able to distribute these thrust force, and one half can be decreased substantially. Thereby, the thrust bearings 66-68 which support said thrust force can be miniaturized or abolished.
[0031] Moreover, instead of the twist direction combining the helical gear of a reverse pair mutually, even if it adopts a **** gear (double helical gear), the same effectiveness can be acquired. However, a **** gear has troublesome processing and has the problem on which cost increases, and the helical gear of this example is easy to process it to it, and it is low cost. And since 52z-- gears with planetary-gear 58x --, 58y--, all gear half object 52x-- of 58z--, and 52y-- to both sun gears 56x, 56y, and 56z and the ring wheels 57x, 57y, and 57z Planetary-gear 58x --, 58y, --, 58z -- Torque-transmission capacity can be raised compared with gear half object 52x --, 52y--, and the case where 52z-- meshes sun gears 56x, 56y, and 56z and ring wheels 57x, 57y, and 57z only to either.
[0032] Next, the 2nd example of this invention is explained based on drawing 6 and drawing 7 .
[0033] Although the motor 31 and the 1st housing 33 of an actuator 28 are arranged in the 1st example at the car-body cross direction, it differs in the 2nd example in that car-body longitudinal-direction arrangement of the motor 31 and the 1st housing 33 of an actuator 28 is carried out along with the posterior part of a torsion bar spring 27. Although the structure of the 1st contained by the 1st housing 33 - the 3rd epicyclic gear devices Px, Py, and Pz is the same as that of the thing of the 1st example, the structure of transmitting rotation of an output shaft 39 to a torsion bar spring 27 is changed according to modification of the orientation of the 1st housing 33.
[0034] That is, in the 1st example, since the output shaft 39 and the toe of a torsion bar spring 27 lay at right angles, rotation of an output shaft 39 was transmitted to the torsion bar spring 27 through the drive bevel gear 40 and the follower bevel gear 42, but in the 2nd example, since the output shaft 39 and the toe of a torsion bar spring 27 are parallel, rotation of an output shaft 39 is transmitted to the torsion bar spring 27 through drive spur-gear 40' and follower spur-gear 42'. A deer can be carried out and the same operation effectiveness as the 1st example can be done so also by this example.
[0035] Next, the 3rd example of this invention is explained based on drawing 8 and drawing 9 .
[0036] To the 1st and 2nd example being equipped with the actuators 28 and 28 of a Uichi Hidari pair corresponding to the wheels W and W on either side, the 3rd example is equipped with the single actuator 71 corresponding to the wheels W and W on either side, and the torsion bar springs 27 and 27 on either side are mutually twisted to hard flow with this actuator 71.
[0037] The housing 72 of an actuator 71 is equipped with the outline cylinder-like housing body 73 with which narrow diameter portion 73a was formed in the location of the central left, the left covering 75 which is combined with the left end section of the housing body 73, and divides the epicyclic gear device receipt room 74, and the right covering 76 combined with the right end section of the housing body 73. The right-hand side torsion bar spring 27 penetrated the interior of housing 72, the toe has extended inside the epicyclic gear device receipt room 74, and the toe of the left-hand side torsion bar spring 27 is being fixed to the left covering 75 of housing 72.
[0038] The epicyclic gear device 77 contained inside the epicyclic gear device receipt room 74 The planetary carrier 78, a ring wheel 79, a sun gear 80, and two or more pinion shaft 81 --, Consist of two or more pinion 82 - -, and the planetary carrier 78 is fixed to the toe of the right-hand side torsion bar spring 27. A ring wheel 79 is fixed to the housing body 73, and the sun gear 80 is being fixed to the tubed revolving shaft 85 supported by the housing body 73 and the right covering 76 by ball bearings 83 and 84. Pinion 82 -- supported by pinion shaft 81 -- fixed to the planetary carrier 78 gears to a ring wheel 79 and a sun gear 80 at coincidence.
[0039] The motor 86 contained by the housing body 73 is equipped with the stator 87 which consists of a permanent magnet fixed to the inner skin of the housing body 73, and Rota 88 which consists of a coil fixed to the periphery of a revolving shaft 85.
[0040] Therefore, if a motor 86 is driven, Rota 88 will rotate to a stator 87, and rotation of Rota 88 is inputted into the sun gear 80 which is the input member of the epicyclic gear device 77 through a revolving shaft 85, is outputted from the planetary carrier 78 which is the output member, and gives torsion of an one direction to the toe of the right-hand side torsion bar spring 27. Consequently, it is transmitted to the left-hand side torsion bar spring 27 through the housing body 73 and the left covering 75 from the stator 87 of a motor 86, and the reaction force of the torsion load of the right-hand side torsion bar spring 27 is contrary to the right-hand side torsion bar spring 27 to the toe of the torsion bar spring 27, and also receives torsion of a direction. Consequently, the torsion bar springs 27 and 27 on either side are mutually twisted to hard flow with equal torque, and can generate the desired roll moment by pushing up one side of the wheels W and W on either side, and depressing another side.
[0041] Since an actuator 71 can be arranged near the car-body center line L, it can avoid that an actuator 71 interferes with a suspension on either side, and the degree of freedom of a layout can be made to increase sharply also by this example. And since the wheels W and W on either side can be moved up and down with the

single actuator 71, compared with the 1st and 2nd example, structure becomes easy, and components mark and cost can be reduced further.

[0042] As mentioned above, although the example of this invention was explained in full detail, this invention can perform design changes various in the range which does not deviate from the summary.

[0043] For example, although the longitudinal-direction heel of torsion bar springs 27 and 27 is connected to lower control arms 12 and 12 in the example, it is connectable with the member (for example, the upper arms 13 and 13 and knuckles 11 and 11) which moves up and down with Wheels W and W. Moreover, although this invention is applied to the suspension of a rear wheel in the example, it is also possible to apply it to the suspension of a front wheel.

[Translation done.]

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The top view of the suspension of the right rear ring of an automobile
[Drawing 2] 2 section expanded sectional view of drawing 1
[Drawing 3] The important section enlarged drawing of drawing 2
[Drawing 4] The 4-4 line sectional view of drawing 2
[Drawing 5] The perspective view of a planetary carrier assembly
[Drawing 6] The top view of the actuator concerning the 2nd example
[Drawing 7] The important section expanded sectional view of drawing 6
[Drawing 8] The top view of the suspension of the right rear ring of the automobile concerning the 3rd example
[Drawing 9] The 9-9 line sectional view of drawing 8
[Description of Notations]
W Wheel
12 Lower Control Arm (Member Which Moves Up and Down with Wheel)
27 Torsion Bar Spring
28 Actuator
31 Motor
71 Actuator
86 Motor
87 Stator
88 Rota

[Translation done.]

* NOTICES *

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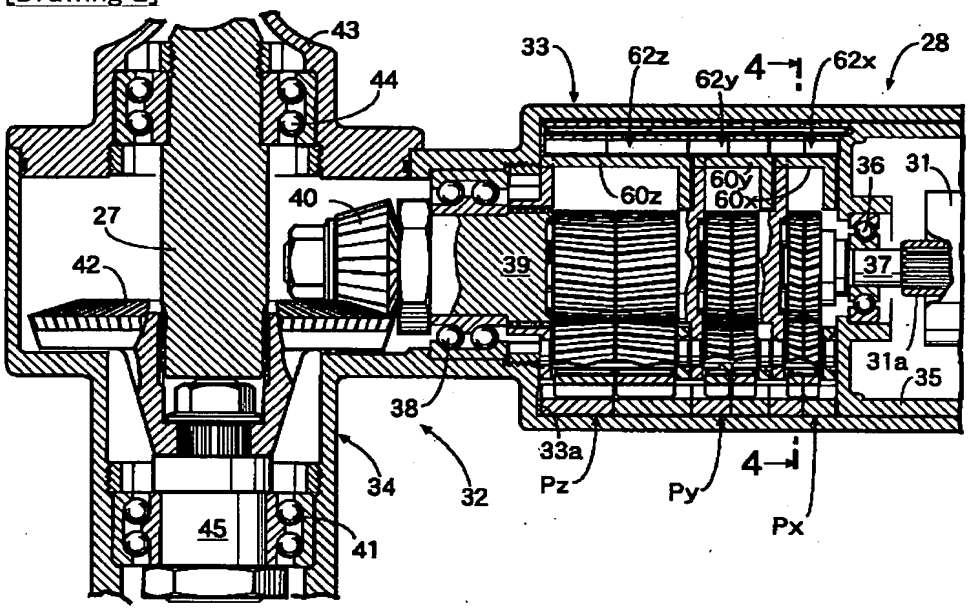
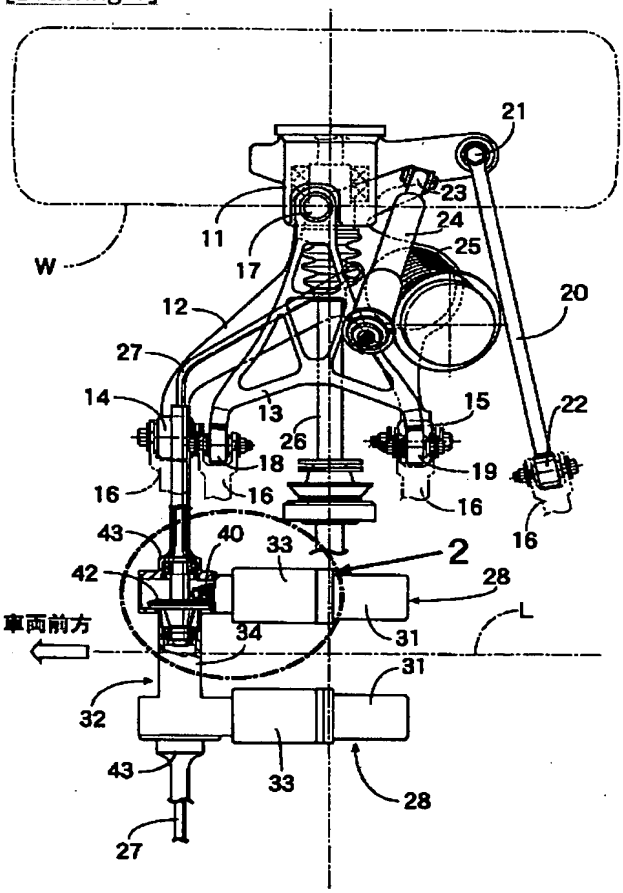
DRAWINGS

[Drawing 2]



[Drawing 1]



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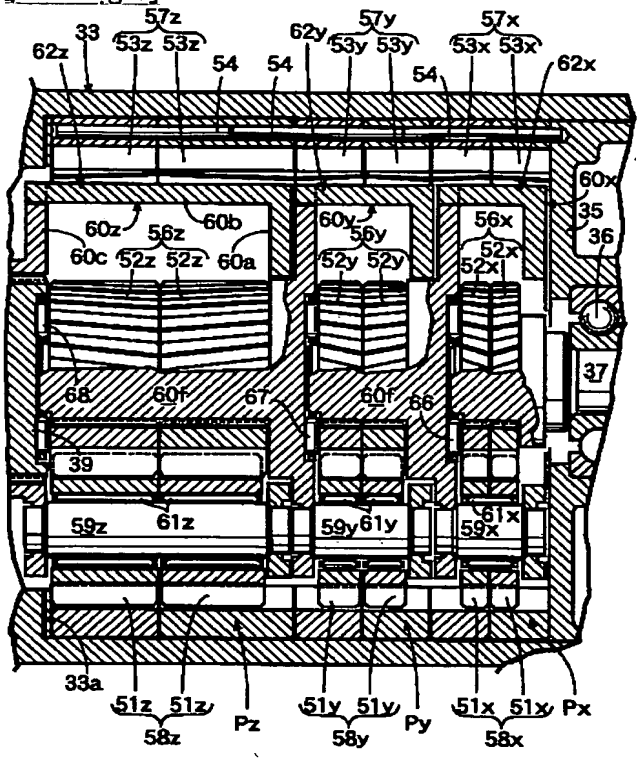

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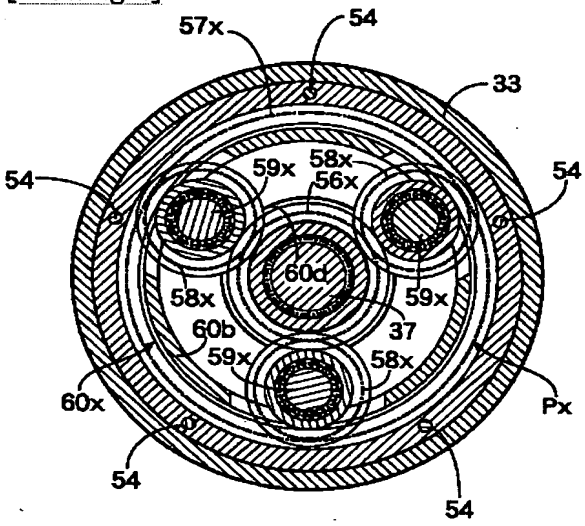
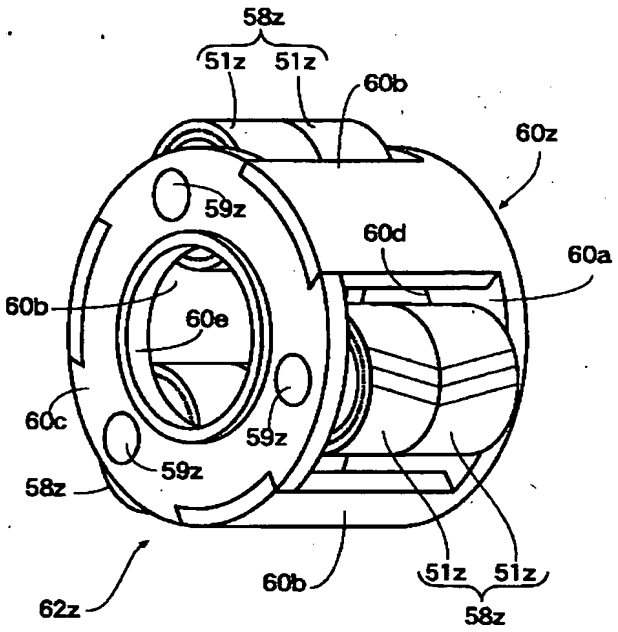


[Drawing 5]



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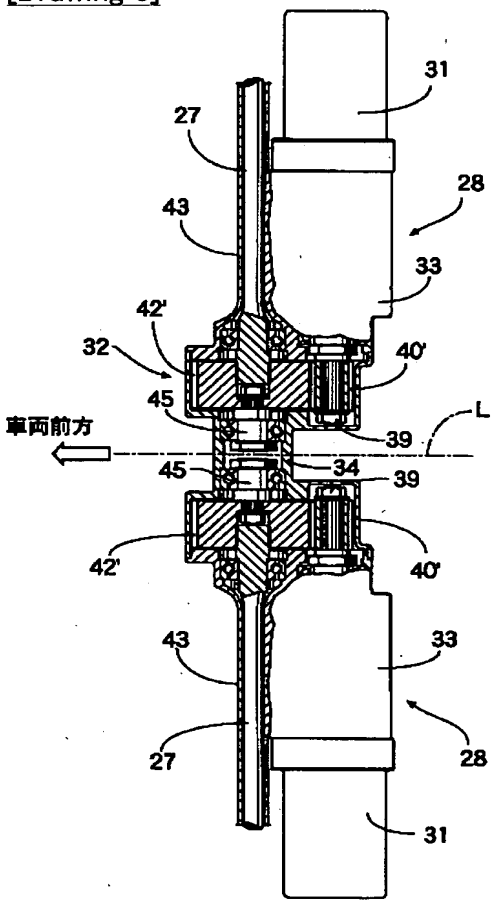

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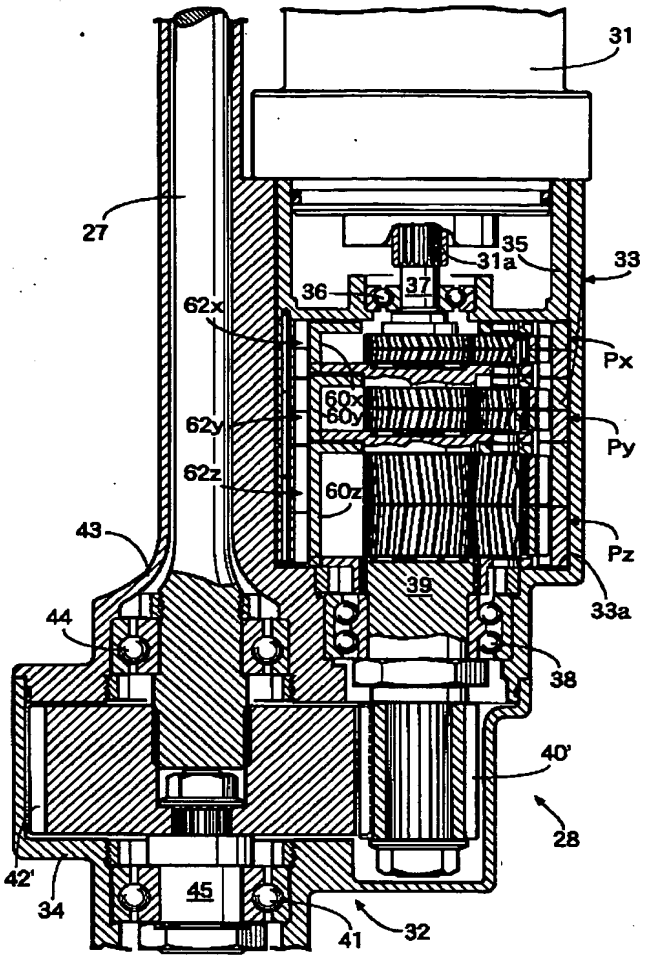
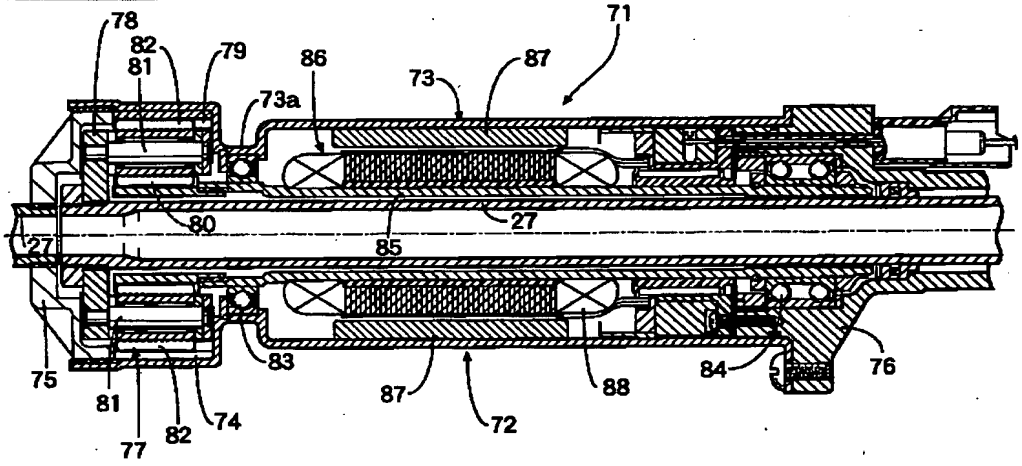
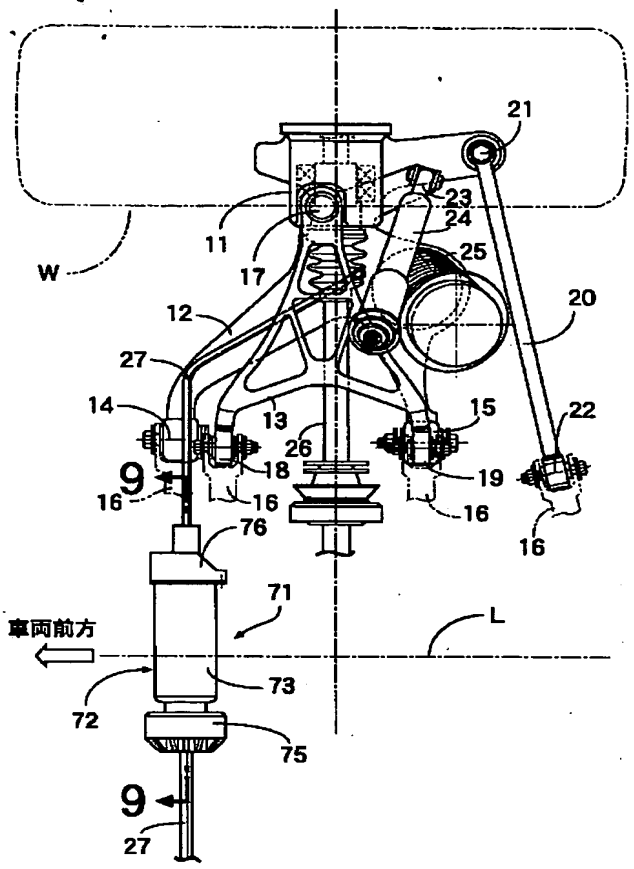


[Drawing 9]



[Drawing 8]



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